Representation of finite metric spaces and image processing

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According to a recently obtained result in [1], each totally bounded metric space can be “embedded" into a finite dimensional Euclidean space with an almost injective function (these notions are precisely defined in [1] and will be recalled in the talk, as well). This makes possible to represent finite metric spaces in a way that algorithmic calculations on these finite metric spaces can be easily implemented in a computer.

In this talk we will apply the methods and results presented in [1] to image processing. More concretely, we will recall definitions of metric spaces whose elements are pictures and the distance function measures the similarities between two pictures. Representing these metric spaces as subspaces of finite dimensional Euclidean spaces (endowed with the usual Euclidean metric) we propose and analyze an algorithm which may be used to recognize human faces. Estimations on accuracy and efficiency will also be discussed.

In more detail, suppose we have a metric in the set of pictures which measures similarity in the following sense. If two pictures are “similar", then their distance is small; if two pictures are “rather different" then their distance is large. Let ε be a fixed positive real number. Applying some results from [1], we obtain, that there exist a finite number n (depending on ε) and a continuous function f mapping the metric space of pictures into the n- dimensional Euclidean space such that if the distance of two pictures is at least ε then their f-images are different.

This makes possible to develop algorithms for image processing, particularly, for face recognition. We implemented some of these algorithms in Matlab. We can apply these algorithms for gray and RGB color images, as well.

[1] G. Sági, Almost injective mappings of totally bounded metric spaces into finite dimensional euclidean spaces, submitted (2018).